E N T R I X

*Excellence in Environmental Consulting Since 1984*

**MEMORANDUM**

2140 Eastman Avenue, Suite 200
Ventura, CA 93003
(805) 644-5948

**To:** Michael Bloom
Michael Pound
Marie Vicario-Fisher
Virginia Lau

**From:** Jennifer Holder, Ph.D.

**Date:** July 2, 2002

**Re:** Sensitivity Analysis for Lead Shot Exposure Model and WOE for Corrected and Uncorrected Amphipod Data for SPL

---

The objective of this memorandum is to conduct a sensitivity analysis on exposure parameters for the Skeet Range binomial probability model and to explore the impact of corrected vs uncorrected amphipod data on the weight of evidence (WOE) approach proposed for SPL.

**Sensitivity analysis**

One of the most critical literature-derived parameters in the probability exposure model proposed for the Skeet Range is "n" or the number of probes per grit (or trials) that a bird makes over a specified time period. The parameter "n" is based on three inputs:

- The number of trials/day which is equivalent to the amount of grit an animal ingests/day;
- The Site Use Factor (SUF) which is the amount of time each day that an animal forages for grit at the Skeet Range;
- The amount of time grit/shot retained in the gizzard.

Additional review of the literature and discussions with avian ecologists resulted in the development of a range of values for the above parameters that could then be evaluated in a sensitivity analysis. Table 1 presents a minimum, mid and maximum value for each of the three inputs and are described in more detail below.

Number of trials/day: Since there were no species-specific information available on grit uptake in scaup or scoter, grit uptake was estimated by assuming that one piece of grit (or shot) is ingested on every foraging dive. Based on San Francisco Bay-specific information, it was estimated that diving ducks conduct approximately 690 foraging dives/day (as presented in the position paper). Proposed ranges for this parameter include:

Is there a way to account for the time they are feeding on bivalves say 50% since they would not be consuming grit / lead shot? Or use SUF as another means?

- Max = # of foraging dives/day or 690 dives/day (as in position paper).
- Mid = 690 dives/day x 0.42 or 289 dives/day. 42% is the percentage in wet weight (WW) of grit found in the gizzard of surf scoters in a stomach contents study conducted in British Columbia. This was the maximum grit content found in the gizzards collected.
- Min = 690 dives/day x 0.02 or 13.8 dives/day. This corresponds to 2% WW grit in the gizzard of scoters which was the low end of the range detected in scoter gizzards the same study.

SUF: SUFs were developed by comparing the amount of time a scaup or scoter forages at the Skeet Range vs. other locations within their home range. Assuming the Skeet Range is about 0.08 km2, ranges of SUFs were:

- Max SUF = 0.05 assumes that the birds forage half the time at the skeet range.
- Mid SUF = 0.01. This is based on the SUF of the scoter based on a home range estimated in Puget Sound (as in position paper).
- Min SUF = 0.004. This is based on a home range estimated for the scaup in S.F. Bay.

Grit Retention Time: To define the time period over which the probability of shot ingestion must be evaluated, a grit or shot retention time was defined. Ranges for this input include:

- Max value = 20 days (as in position paper).
- Mid value = 10 days. This is based on an experimental grit turnover rate of 0.54/48 hr interval which results in only 5% of grit remaining in the gizzard after 10 days. This assumes that shot turns over at the same rate as grit.
- Min value = 4 days. This is based on a grit turnover rate calculated for mallard ducklings.

Table 1 presents the impact of these values on estimating the probability of ingesting $\geq$ the effect level of shot (10 shot) when an arithmetic mean of the shot and grit measured at the Skeet Range is used in the model. Estimation of exposure point concentrations in the Skeet range RI will likely result in different values than those used here for illustrative purposes. Values in red are those estimated probabilities that exceed a 1 in 10,000 probability (as used by Chevron in their Skeet Range risk assessment). Figure 1 presents the sensitivity analysis graphically. As one can see, the most sensitive parameter is the SUF. Nearly all the probabilities calculated for a SUF of 0.5 result in probabilities that exceed 10-4 and most result in probabilities of 1. SUFs of 0.01 and 0.004 only result in probabilities above 10-4 for the max trials/day and retention times.

Recommendation: Based on professional judgment, an additional review of the literature, and discussions with avian biologists, the following recommendations are made and proposed as amendments to the position paper:

1. Trials/day = a range of 289 as the high and 13.8 as the low. 690 trials/day assumes that grit is ingested on every foraging dive, which is unrealistic and

over-conservative and should not be presented as a possible input parameter.
2. SUF: 0.01 and 0.004 be used as the high and low estimate.
3. Grit retention time: 20 days as the max and 10 days as the min. A retention time of 4 days based on a duckling study does not seem appropriate for modeling to adult diving ducks.

**Amphipod Correction Factor**

Integrated WOE scores were calculated for the ten 1998 SPL sample locations using both uncorrected amphipod data and applying an 18% correction factor (Figures 2 and 3). These scores are shown spatially at SPL on Figures 4 and 5. WOE scores without the amphipod correction factor (Figures 2 and 4) and using the "brightline criteria" defined for HPS identify SP02 as requiring remediation. All other stations are gray and would require further evaluation to define a path forward. WOE scores using the corrected amphipod scores (Figures 3 and 5) identify 4 stations as clearly not requiring remediation (SP05, SP08, SP09 SP10) and no station is clearly defined as requiring remediation.. All other stations are gray and require further evaluation to define a path forward. Further evaluation includes analysis of ancillary data.

Table 1: Sensitivity Analysis for Probability Model

| Range | # of Trials/Day | Grit retention time (days) | SUF |
|---|---|---|---|
| min | 13.800 | 4 | 0.04 |
| mean | 289.000 | 10 | 0.1 |
| max | 690.000 | 20 | 0.5 |

0.01

Step 1: n=#trials/day x Grit Retention Time x SUF
Step 2: p = f(Ashot/Agrit)
Step 3: Probability of ingesting > effect level use binomial function

580
5.5 / 10 days
.224 / ## days

| # of Trials/Day | Grit retention time (days) | SUF | "n" | f | Ashot/Agrit | "p" Probability of ingesting one lead shot | Effect Level (# of shot) | *Probability of ingesting > Effect level* |
|---|---|---|---|---|---|---|---|---|
| 13.800 | 4 | 0.004 | *10.00* | 0.18 | 0.30 | 0.05 | 10.00 | *2.35E-13* |
| 13.800 | 4 | 0.01 | *10.00* | 0.18 | 0.30 | 0.05 | 10.00 | *2.35E-13* |
| 13.800 | 4 | 0.5 | 27.60 | 0.18 | 0.30 | 0.05 | 10.00 | 8.36E-07 |
| 13.800 | 10 | 0.004 | *10.00* | 0.18 | 0.30 | 0.05 | 10.00 | *2.35E-13* |
| 13.800 | 10 | 0.01 | *10.00* | 0.18 | 0.30 | 0.05 | 10.00 | *2.35E-13* |
| 13.800 | 10 | 0.5 | 69.00 | 0.18 | 0.30 | 0.05 | 10.00 | 4.14E-03 |
| 13.800 | 20 | 0.004 | *10.00* | 0.18 | 0.30 | 0.05 | 10.00 | *2.35E-13* |
| 13.800 | 20 | 0.01 | *10.00* | 0.18 | 0.30 | 0.05 | 10.00 | *2.35E-13* |
| 13.800 | 20 | 0.5 | 138.00 | 0.18 | 0.30 | 0.05 | 10.00 | 2.22E-01 |
| 289.000 | 4 | 0.004 | *10.00* | 0.18 | 0.30 | 0.05 | 10.00 | *2.35E-13* |
| 289.000 | 4 | 0.01 | 11.56 | 0.18 | 0.30 | 0.05 | 10.00 | 2.45E-12 |
| 289.000 | 4 | 0.5 | 578.00 | 0.18 | 0.30 | 0.05 | 10.00 | 1.00E+00 |
| 289.000 | 10 | 0.004 | 11.56 | 0.18 | 0.30 | 0.05 | 10.00 | 2.45E-12 |
| 289.000 | 10 | 0.01 | 28.90 | 0.18 | 0.30 | 0.05 | 10.00 | 1.24E-06 |
| 289.000 | 10 | 0.5 | 1,445.00 | 0.18 | 0.30 | 0.05 | 10.00 | 1.00E+00 |
| 289.000 | 20 | 0.004 | 23.12 | 0.18 | 0.30 | 0.05 | 10.00 | 1.39E-07 |
| 289.000 | 20 | 0.01 | 57.80 | 0.18 | 0.30 | 0.05 | 10.00 | 9.52E-04 |
| 289.000 | 20 | 0.5 | 2,890.00 | 0.18 | 0.30 | 0.05 | 10.00 | 1.00E+00 |
| 690.000 | 4 | 0.004 | 11.04 | 0.18 | 0.30 | 0.05 | 10.00 | 2.45E-12 |
| 690.000 | 4 | 0.01 | 27.60 | 0.18 | 0.30 | 0.05 | 10.00 | 8.36E-07 |
| 690.000 | 4 | 0.5 | 1,380.00 | 0.18 | 0.30 | 0.05 | 10.00 | 1.00E+00 |
| 690.000 | 10 | 0.004 | 27.60 | 0.18 | 0.30 | 0.05 | 10.00 | 8.36E-07 |
| 690.000 | 10 | 0.01 | 69.00 | 0.18 | 0.30 | 0.05 | 10.00 | 4.14E-03 |
| 690.000 | 10 | 0.5 | 3,450.00 | 0.18 | 0.30 | 0.05 | 10.00 | 1.00E+00 |
| 690.000 | 20 | 0.004 | 55.20 | 0.18 | 0.30 | 0.05 | 10.00 | 7.12E-04 |
| 690.000 | 20 | 0.01 | 138.00 | 0.18 | 0.30 | 0.05 | 10.00 | 2.22E-01 |
| 690.000 | 20 | 0.5 | 6,900.00 | 0.18 | 0.30 | 0.05 | 10.00 | 1.00E+00 |

Figure 1: Sensitivity Analysis

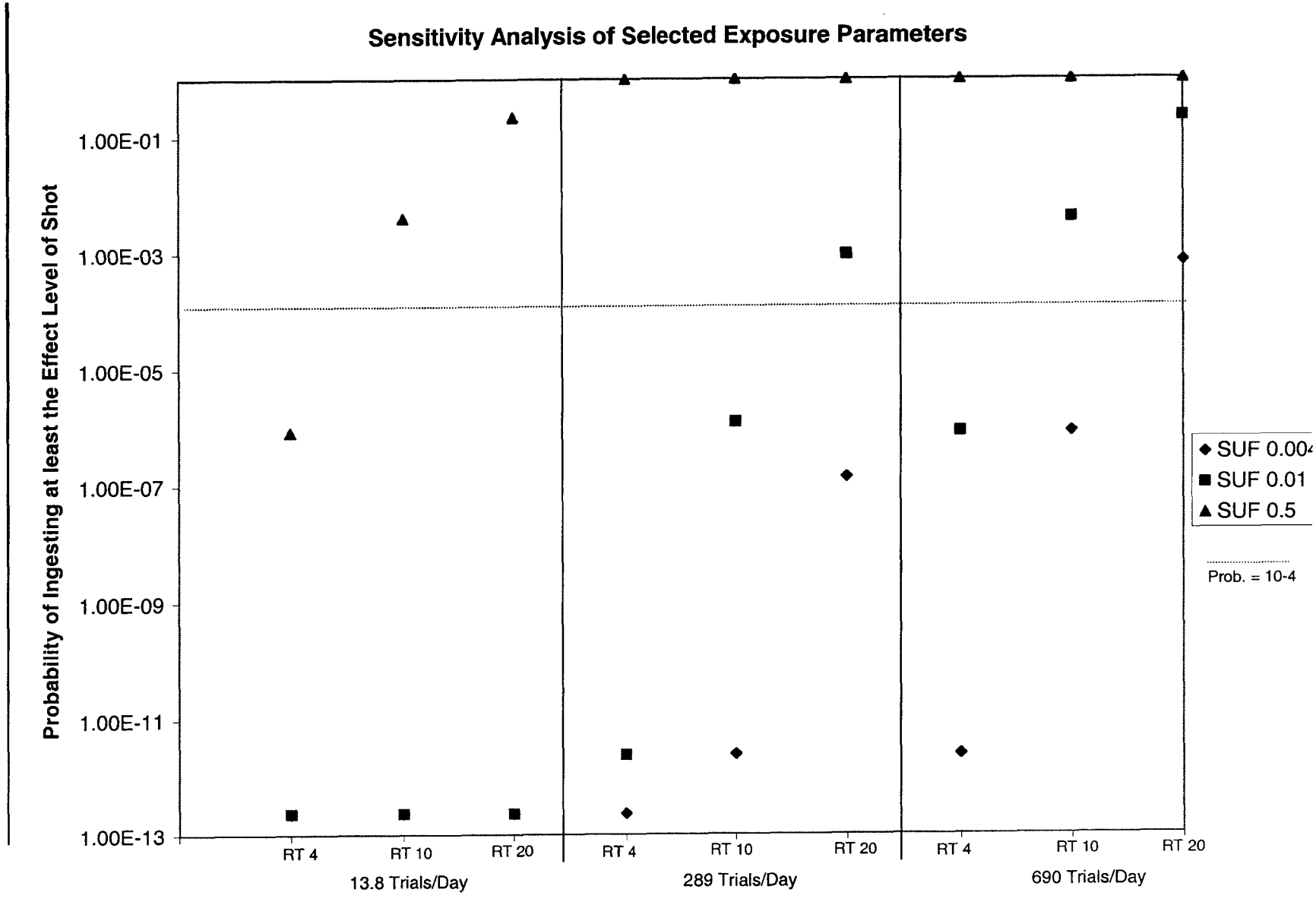


**Figure 2: WOE Scores for SPL w/o Amphipod Correction Factor**

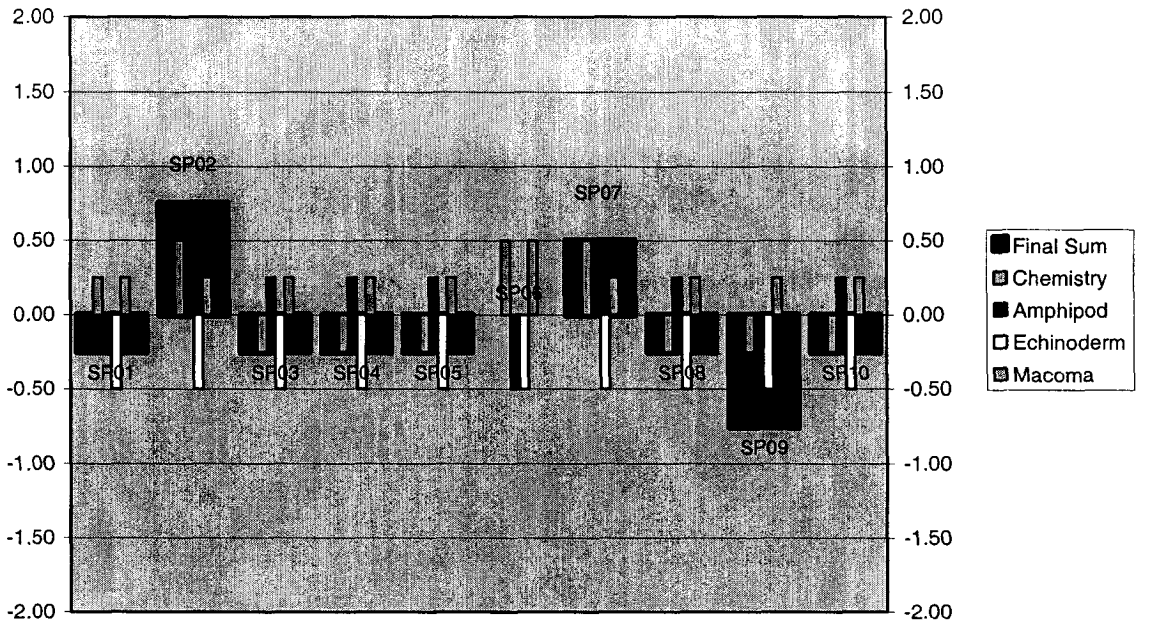
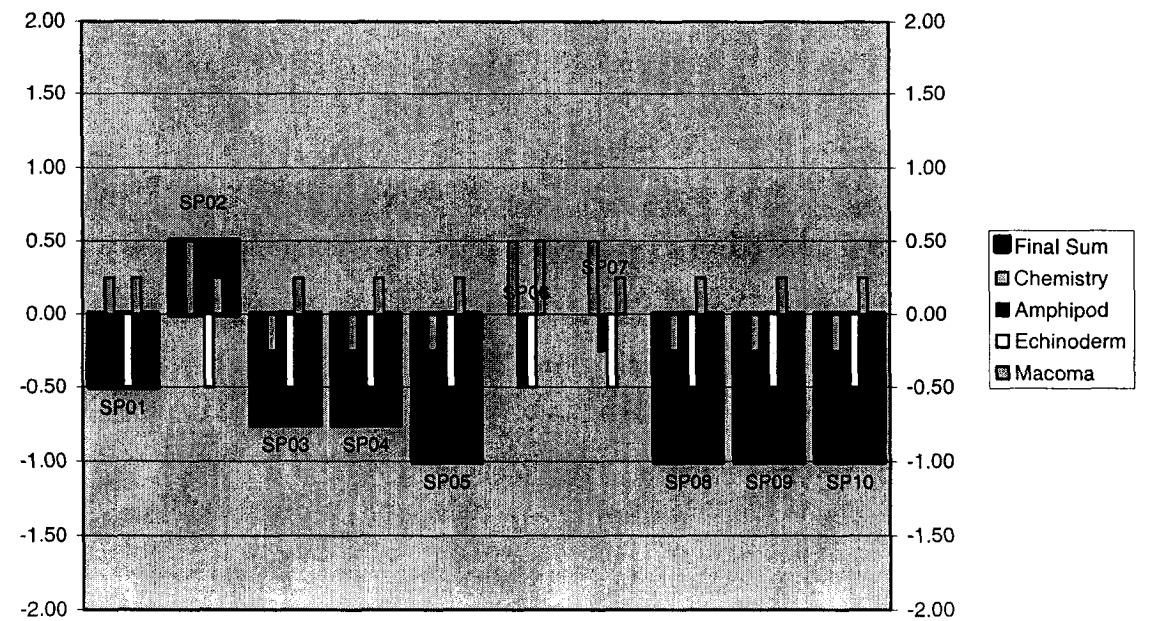



**Figure 3: WOE Scores for SPL w/ Amphipod Correction Factor**



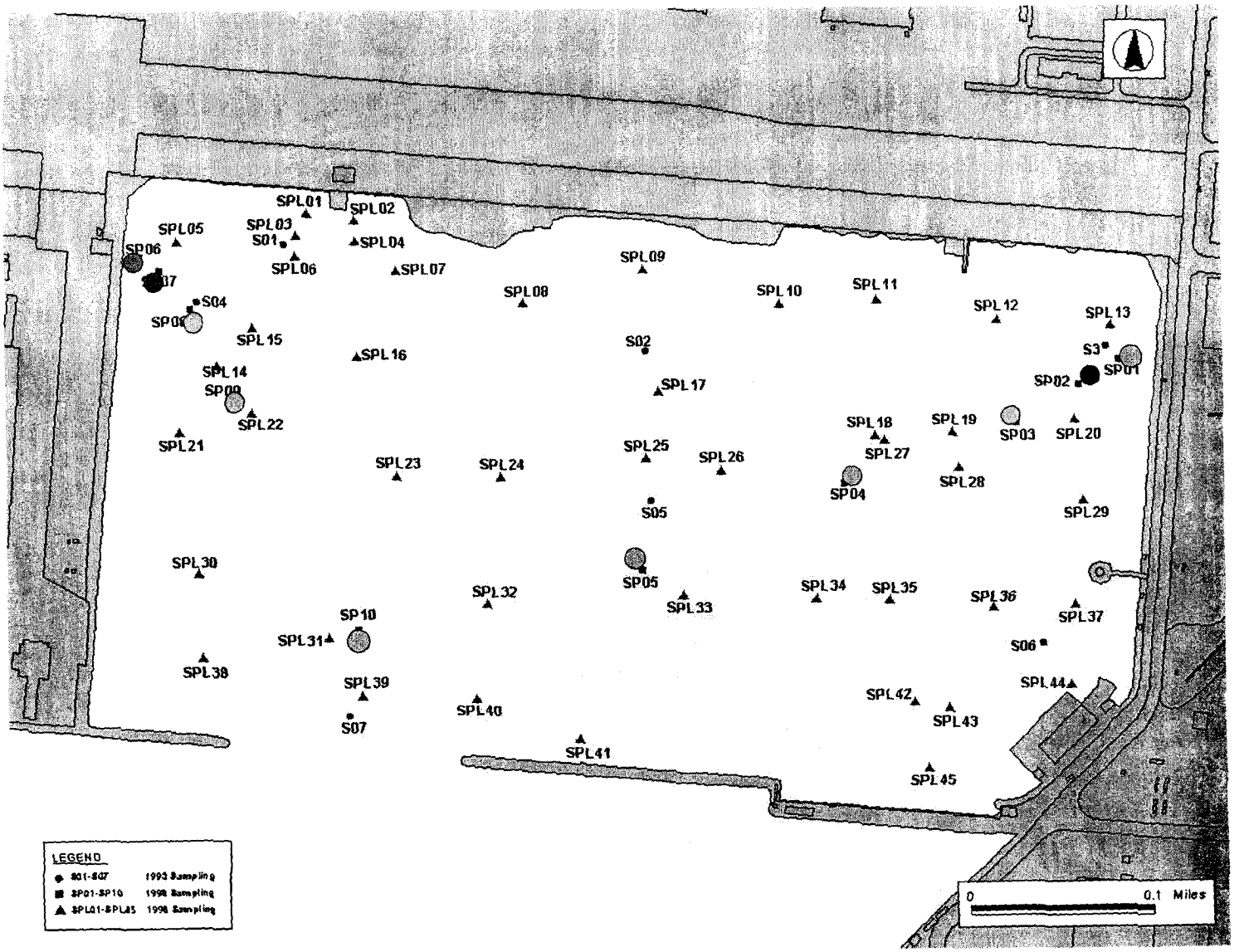



Figure 4: Map of Uncorrected WOE scores

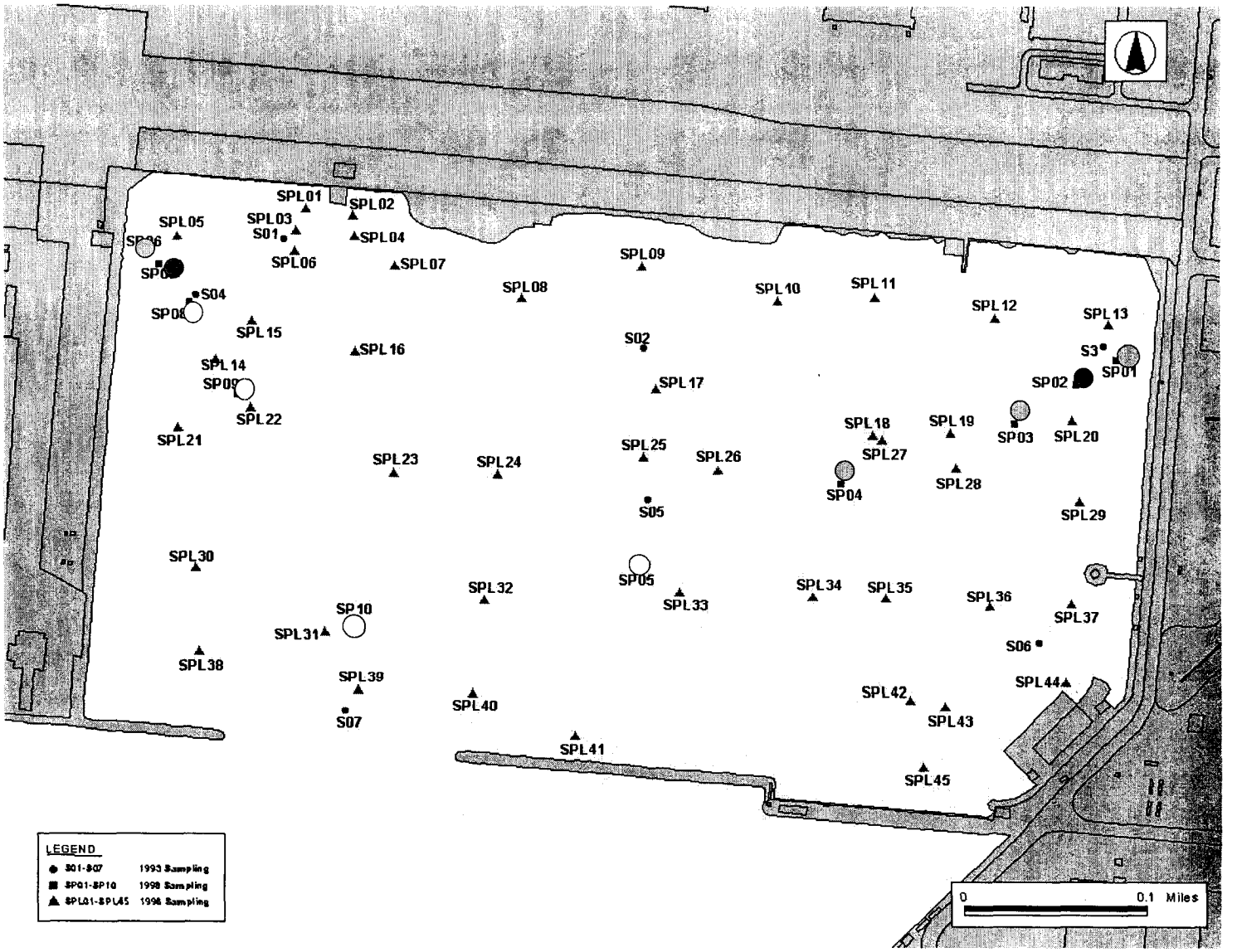



Figure 5: Map of Corrected WOE Scores